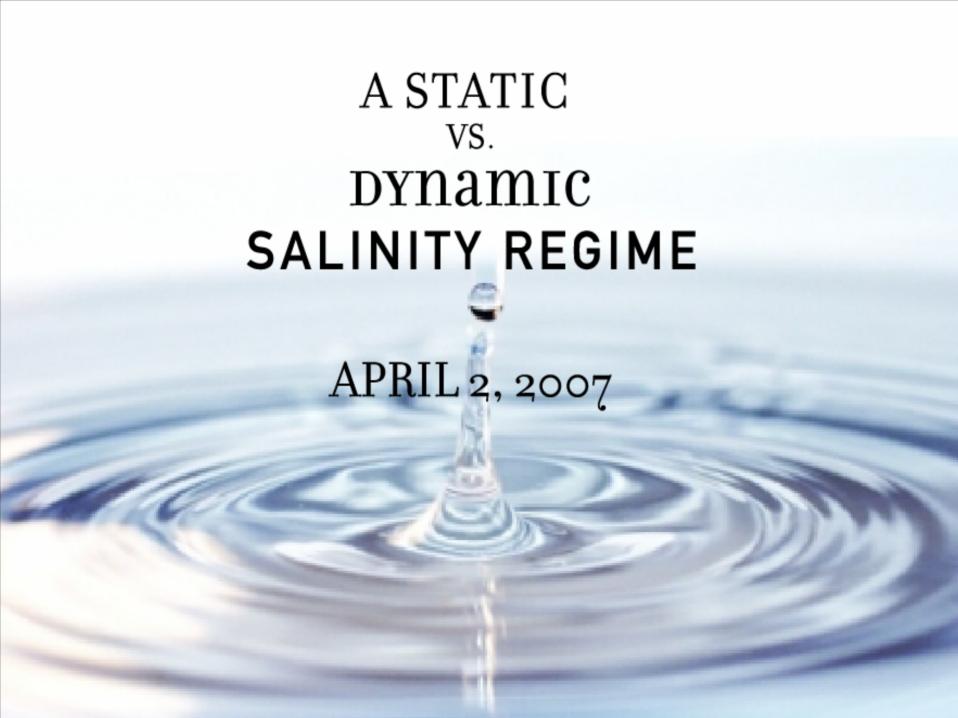
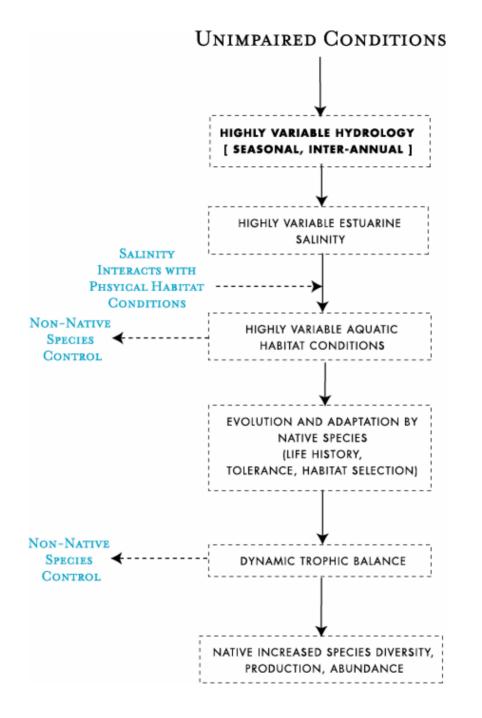
Handout #3

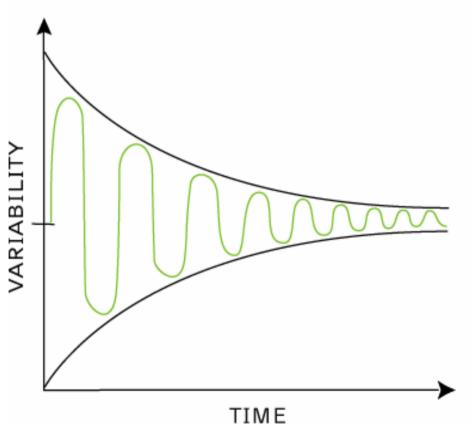
Chuck Hanson Presentation Slides From the April 2, 2007 Workgroup Meeting



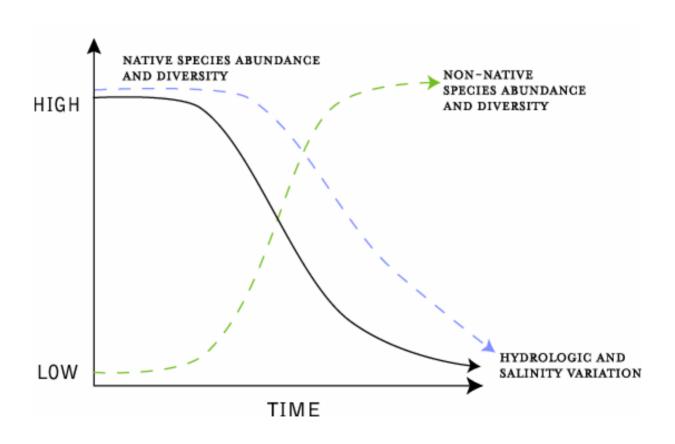


Environmental Variation

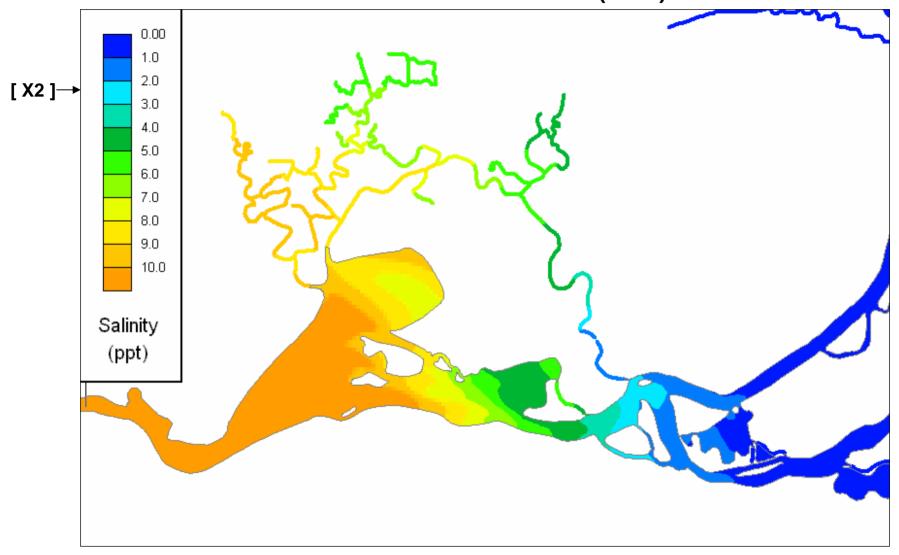




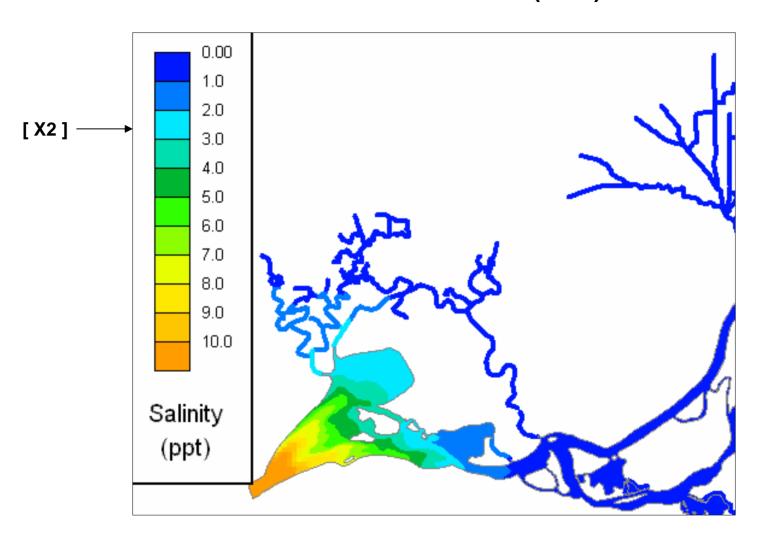
SALINITY VARIATION VS. SPECIES ABUNDANCE



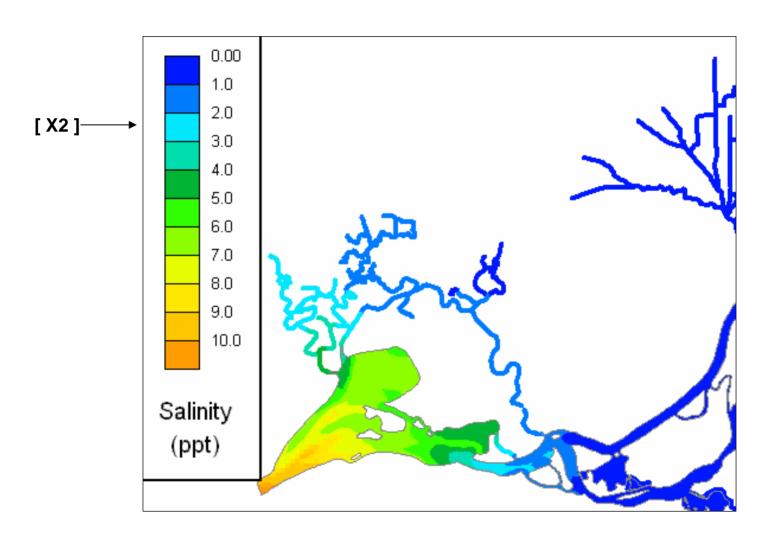
SALINITY GRADIENT AND X2 LOCATION DURING JULY OF A CRITICAL WATER YEAR (1992)



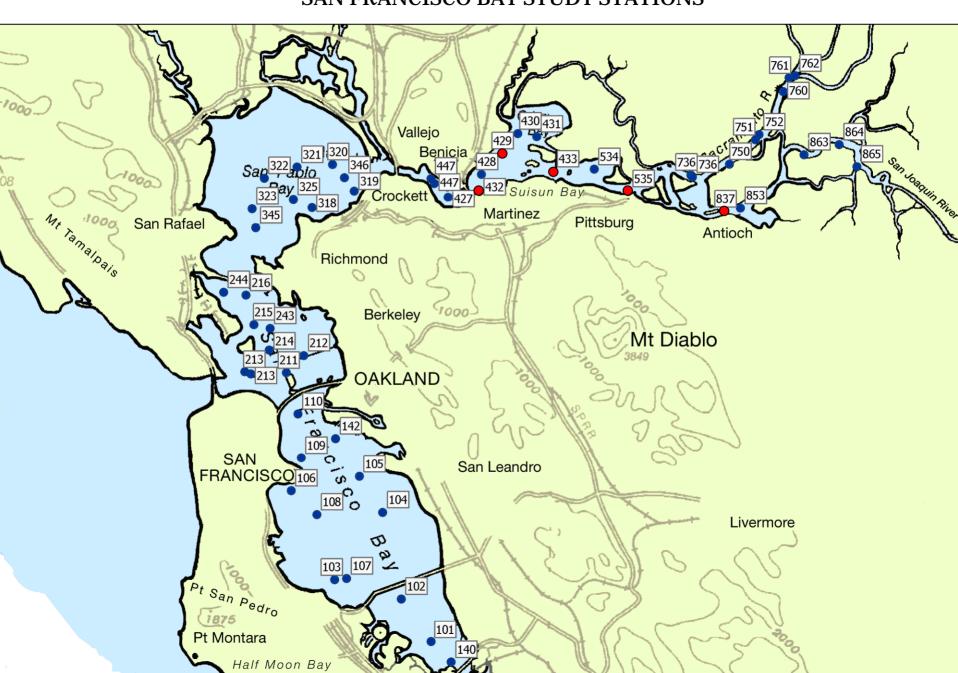
SALINITY GRADIENT AND X2 LOCATION DURING JULY OF A WET WATER YEAR (1999)



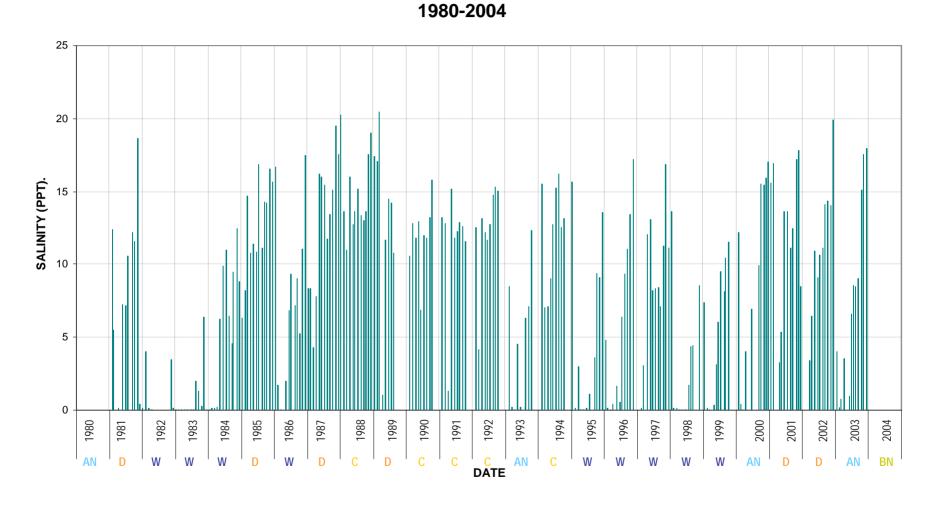
SALINITY GRADIENT AND X2 LOCATION DURING SEPTEMBER OF A WET WATER YEAR (1999)



SALNITY MEASURED AT SUISUN BAY SAN FRANCISCO BAY STUDY STATIONS



NORTH SUISUN BAY CHANNEL NEAR RESERVE FLEET ANCHORAGE DFG BAY STUDY STATION 429

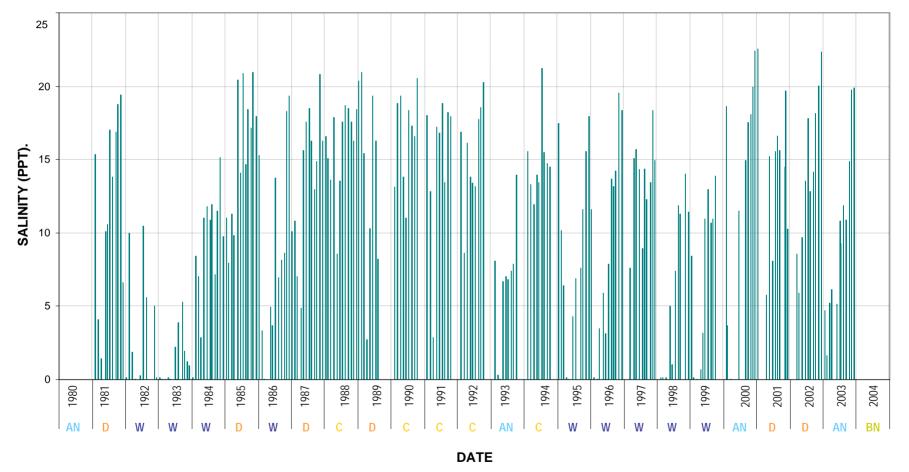


SACRAMENTO RIVER INDEX

W = Wet year type BN = Below normal year type AN = Above normal year type
D = Dry year type

SUISUN BAY, SACRAMENTO RIVER CHANNEL EAST OF HWY 680 BRIDGE

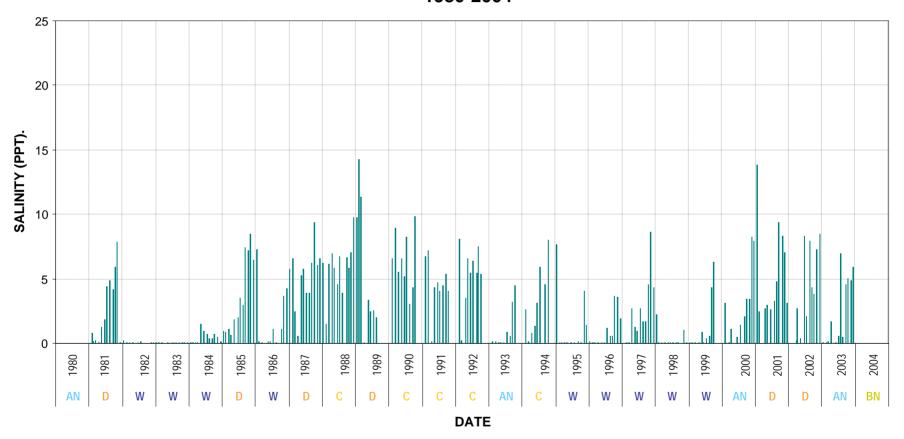
DFG BAY STUDY STATION 432 1980-2004



SACRAMENTO RIVER INDEX

W = Wet year type BN = Below normal year type AN = Above normal year type
D = Dry year type

SACRAMENTO RIVER, CHANNEL S. - CHIPPS ISLAND DFG BAY STUDY STATION 535 1980-2004

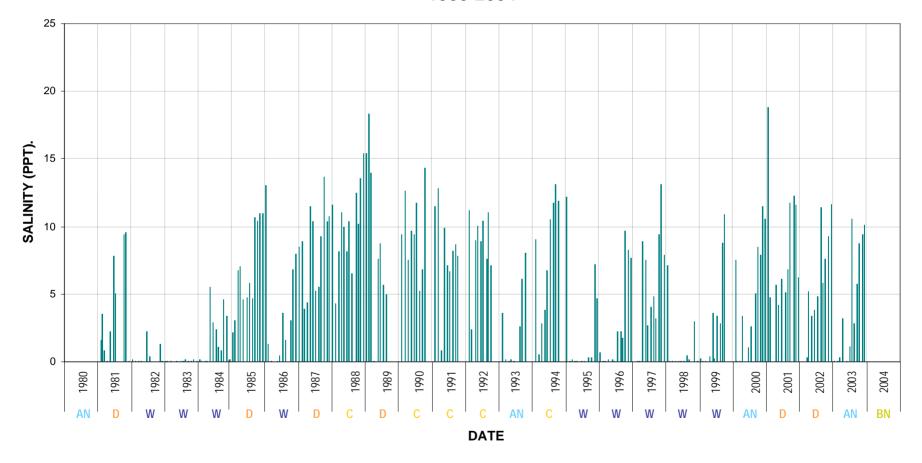


SACRAMENTO RIVER INDEX

W = Wet year type BN = Below normal year type AN = Above normal year type
D = Dry year type

SACRAMENTO RIVER CHANNEL NEAR PORT CHICAGO

DFG BAY STUDY STATION 433 1980-2004



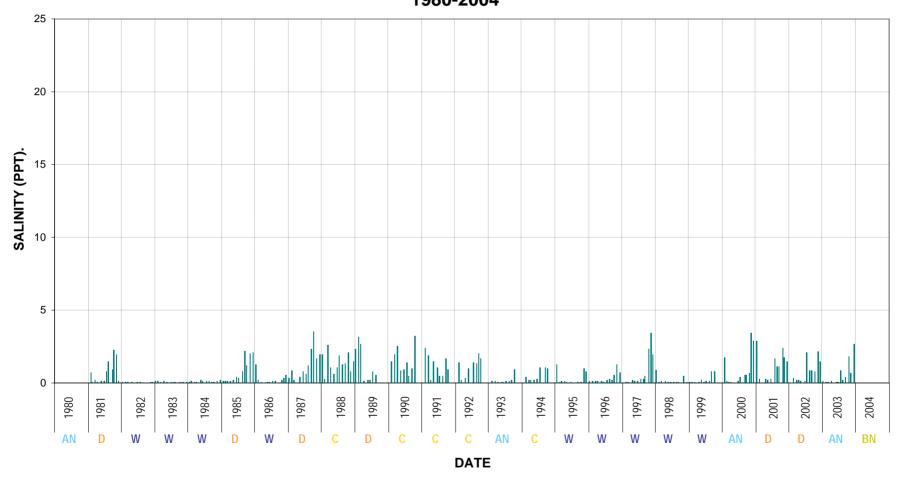
SACRAMENTO RIVER INDEX

W = Wet year typeBN = Below normal year type

AN = Above normal year type
D = Dry year type

SAN JAOQUIN RIVER SHL. BETWEEN WEST ISLAND AND ANTIOCH BRIDGE

DFG BAY STUDY STATION 837 1980-2004



SACRAMENTO RIVER INDEX

W = Wet year type BN = Below normal year type AN = Above normal year type
D = Dry year type

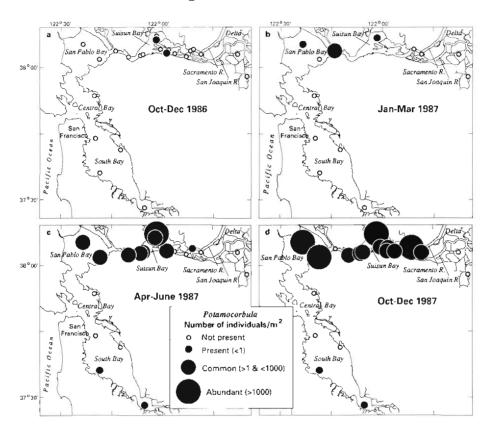
Corbula Salinity Tolerance

LIFESTAGE	SALINITY (PSU)
Adults	2 - 30
Spawning and fertilization	5 - 25
Eggs and sperm	± 10
Embryos (2 hr old)	10 - 30
Embryos (24 hr old)	2 - 30

Egeria Salinity Tolerance	SALINITY (PSU)	
Apparent Preferred Range	0 - 1.2	
Apparent Upper Range	4 - 5	

Corbicula Salinity Tolerance	SALINITY (PSU)	
Apparent Preferred Range	0 - 2	
Apparent Upper Range	3 - 4	

Asian Clam [Potamocorbula amurensis]

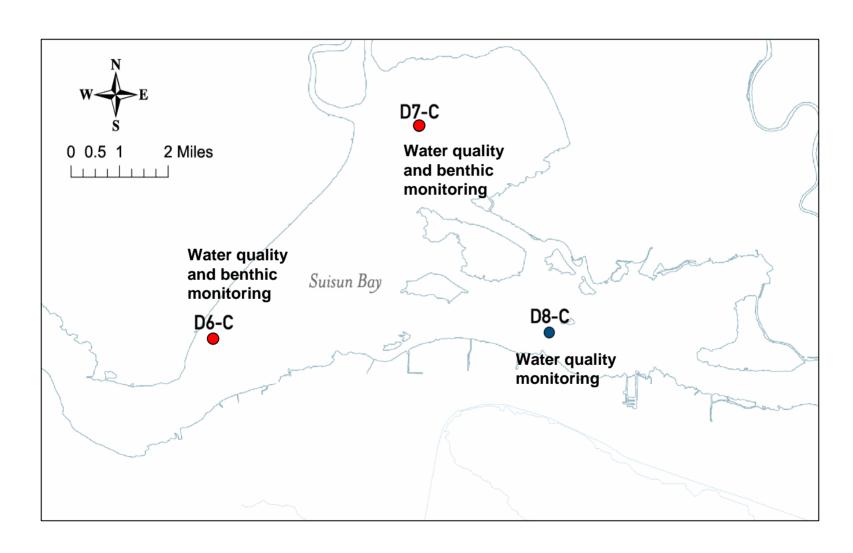


Potamocorbula amurensis. Distribution and relative abundances in San Francisco Bay, October 1986 to December 1987. Abundance data are based upon maximum abundance found at each station during each quarter shown. In [b], DVC did not sample during this period.

(Source: Carlton 1990)

SUISUN BAY SALINITY AND BENTHIC MONITORING

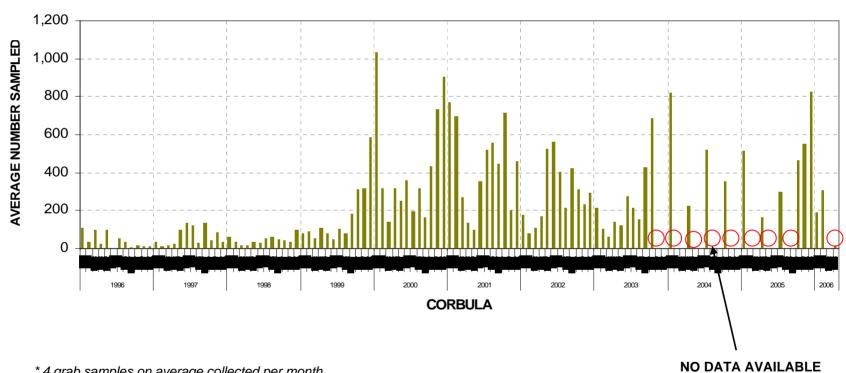
DEPARTMENT OF WATER RESOURCES ENVIRONMENTAL MONITORING PROGRAM DATA



AVERAGE NUMBER OF CORBULA SAMPLES PER MONTH IN WESTERN SUISUN BAY*

DEPARTMENT OF WATER RESOURCES ENVIRONMENTAL MONITORING PROGRAM DATA

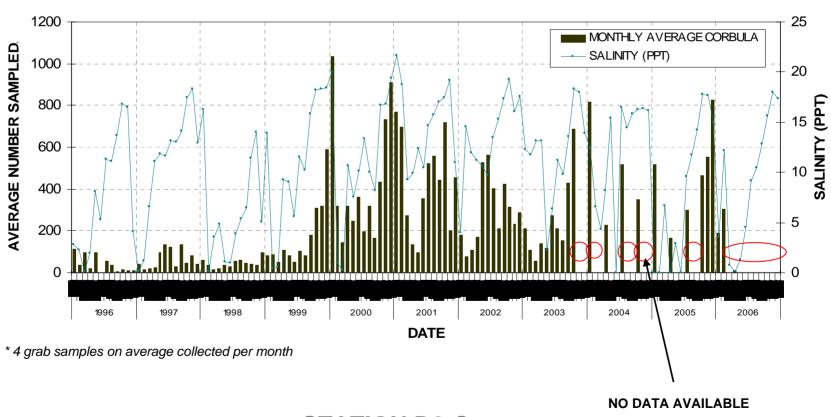
TOTAL NUMBER OF SAMPLES PER MONTH IN SUISUN BAY



^{* 4} grab samples on average collected per month

AVERAGE MONTHLY SALINITY VS. CORBULA ABUNDANCE IN SUISUN BAY

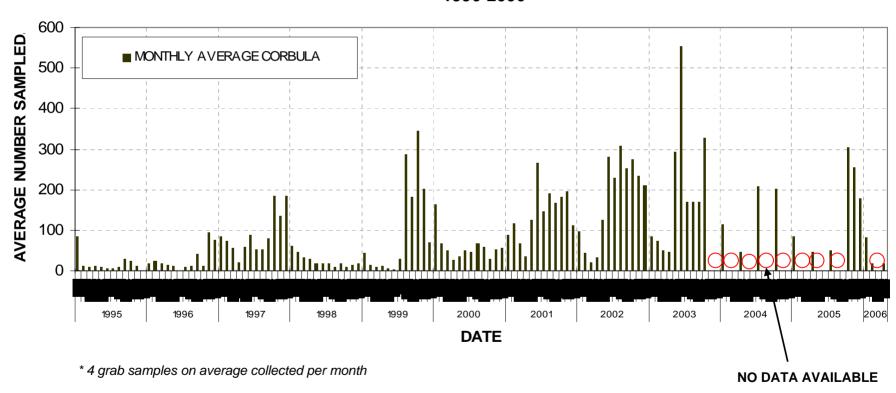
DEPARTMENT OF WATER RESOURCES ENVIRONMENTAL MONITORING PROGRAM DATA



STATION D6-C

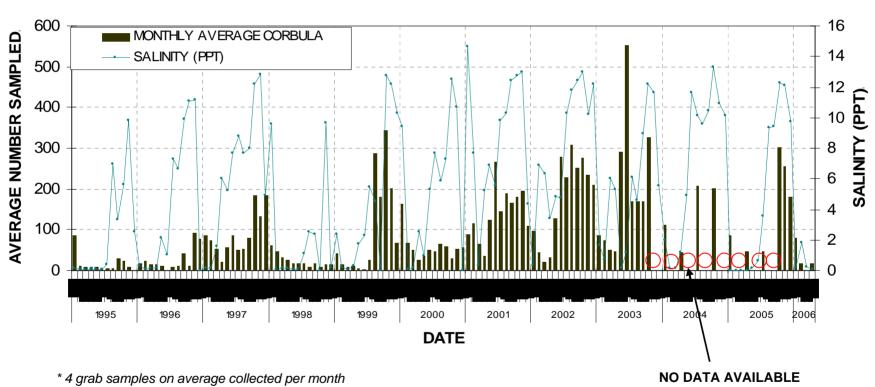
AVERAGE NUMBER OF SAMPLES PER MONTH IN NORTHERN SUISUN BAY / GRIZZLY BAY*

DEPARTMENT OF WATER RESOURCES ENVIRONMENTAL MONITORING PROGRAM DATA 1996-2006

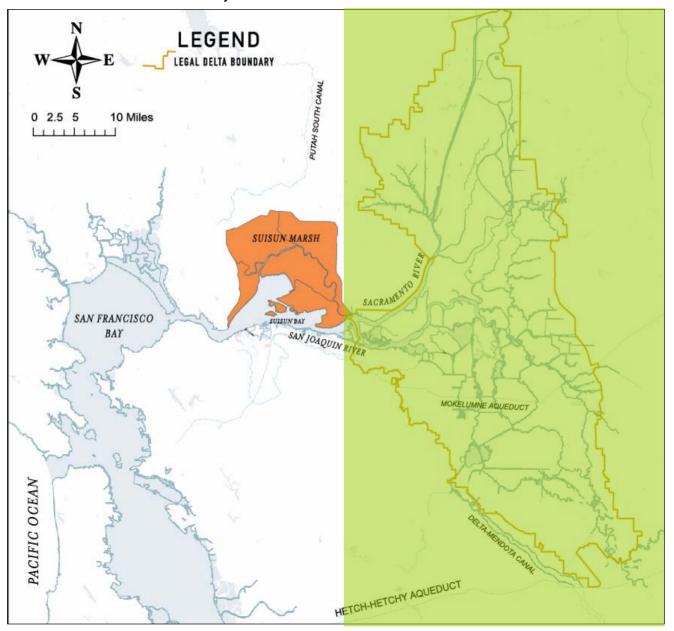


AVERAGE MONTHLY SALINITY VS. CORBULA ABUNDANCE IN SUISUN BAY

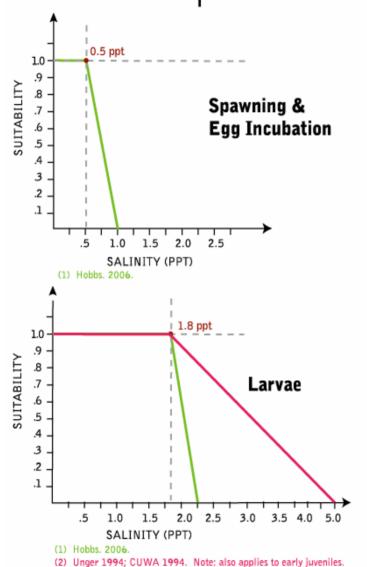
DEPARTMENT OF WATER RESOURCES
ENVIRONMENTAL MONITORING PROGRAM DATA

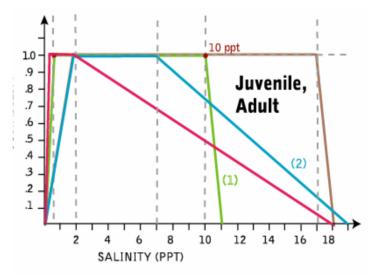


MAP OF THE DELTA SHOWING REGION OCCUPIED BY EGERIA, CORBICULA, AND WATER HYACINTH



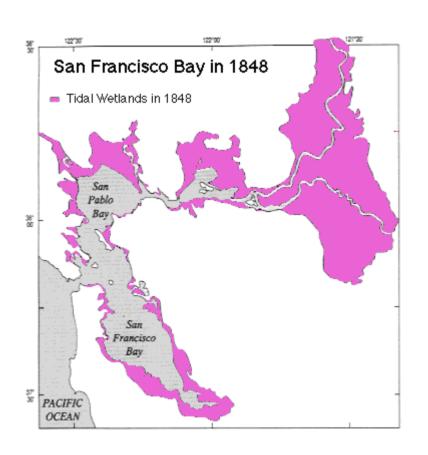
Delta Smelt | SALINITY

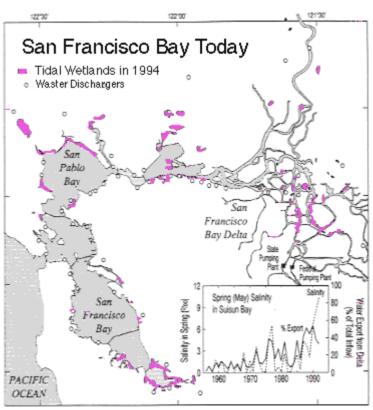




- (1) Hobbs. 2006.
- (2) Moyle. 2002; Swanson and others 2000.
- (3) DWR/USBR 1993; assumes psu.
- (4) Barraclough, 1964.

The San Francisco Bay Estuary & Delta at the time of the discovery of gold in the Sierra Nevada foothills





and at present

(Source: Nichols 2006)

STATIC SALINITY (water use managed)

- Leads to more predictable habitat conditions; easier compliance determination
- O Effect on abundance and distribution of non-native species unknown
- o Increased habitat stability
- O Current operations have not proven to be effective
- o Poor record of habitat manipulation
- Business as usual conservative condition (low risk low reward)
- o Primarily species-specific management
- o Improves habitat conditions downstream in Suisun Bay
- Upstream habitat manipulation desirable but not required
- Intended to transport species to Suisun Bay downstream of export influence
- o No major changes required
- o May result in irreversible impacts
- 0 No impacts to Suisun Marsh operations and species
- o Conventional compliance management
- Aquatic community will continue but <u>may</u> be substantially different than native assemblage/ potentially greater abundance of non-native species (some desirable – largemouth and striped bass)
- Interim and possible long-term conditions
- No biological consensus to change current conditions

Future success - uncertain

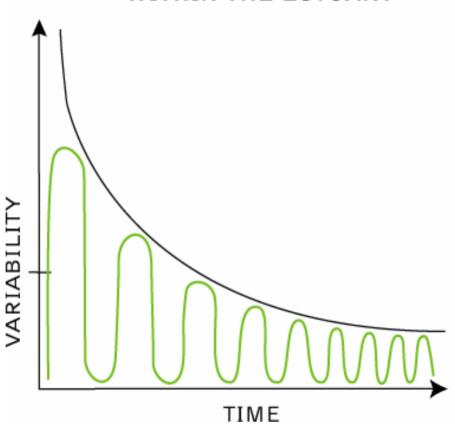
DYNAMIC SALINITY (eco managed)

- 0 Mimics natural seasonal salinity variation; more difficult to determine compliance
- May help control non-native species response of species to variable salinity unknown (magnitude and duration)
- o Increased habitat diversity
- o High degree of uncertainty in biological response
- o Poor record for habitat manipulation
- Large scale change massive environmental manipulation and experiment (high risk potentially high reward)
- o Ecosystem level management
- o Poor relationship with current upstream habitat conditions
- o May require upstream habitat modifications to be effective
- o May result in species located closer to exports may require intake relocation
- o Major land use and infrastructure modifications required
- o May result in irreversible impacts
- 0 Impact to current Suisun Marsh operations and species
- o Contemporary estuarine concepts for management
- Aquatic community will continue but <u>may</u> reflect a balance of native and non-native species with a possible reduction in the abundance of "desirable" non-native species (e.g., largemouth bass)
- o Potential long-term operations
- 0 Weak biological consensus to change current conditions

Future success - uncertain

Environmental Variation

WITHIN THE ESTUARY



QUESTIONS?